SUPPLY CHAIN MANAGEMENT IN FERTILIZER INDUSTRY

With Special Reference to

NAGARJUNA FERTILIZERS AND CHEMICALS LIMITED, KAKINADA

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SYNOPSIS

INTRODUCTION:

This thesis deals with the study of the supply chain management in fertilizer industry with special reference to Nagarjuna Fertilizers and Chemicals Limited, Kakinada more specifically, with the supply chain primary activities such as sourcing of natural gas (inbound logistics), manufacturing of ammonia and urea, product storage, dispatch of products (outbound logistics) for distribution and sale.

Business in global environment should face opportunities and threats regardless of location and market. Firms cannot isolate themselves from ignoring external factors such as economic trends, technology innovations in other countries. Companies are going global truly with Supply-chain Management (SCM). A company can design and develop the product in United States, manufacture in India and sells in Europe. The Companies have changed the methods by which they manage their operations and supply chain activities. The spread and modernization of infrastructures and transport has also changed the trade and the intensified competition has elevated the importance of supply chain management to new levels.

SCM & Outsourcing

Economics and institutional Liberalization, Privatization and Globalization (LPG) increased the competitiveness of the corporate. A number of factors changed globalization dramatically since the last decade. As a result the corporate faced increasing competition from global firms. The drivers of globalization are the reduction of tariffs, improved transportation systems, information and communication technology, and availability of global markets, products and services. These changes have enabled the global competitors to make the products and services available to customers worldwide. These pressures have led to increased emphasis on re engineering internal business processes and improve services to customers and as a means to reduce costs, and better supply chain throughout the planning and operations working in closer collaboration with suppliers. Products and services, changes in technology and globalization have increased the most dynamic markets and greater uncertainty in customer demand. Users can access more goods and services in the market. Therefore, to understand the company's competitive position, changes in customer demands and the requirements for the goods and services depends on its ability to respond. SCM tools and technology allows organizations to respond to the environmental changes and policies.

Therefore these are the reasons why SCM has become essential during the last decade. This intensified competition had driven the business world to look for core competencies and enhanced performance. If a particular organization in some country has the core competence for a certain product or service, it will get the business for that product or service. This is called global outsourcing.

Supply Chain Management

According to Lambert and Stock (1993) logistics, a widely accepted term by today's professionals, had in the past a variety of names including physical distribution, supply chain management and business logistics. The Council of Logistics Management defines logistics as "The process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements" According to the above definition logistics consists of the following four flows:

Material Flow: Flow of materials from their sources through necessary processes including their storage, retrieval and the delivery of raw materials.

Merchandise Flow: Flow of finished goods from the factory to the end user in the distribution channels.

Money Flow: Flow of money including advances from organizations to suppliers of raw materials, energy, services, etc. and into organizations from the wholesalers, distributors, customers, etc.

Information Flow: Flow of required information from and into the organization through various communication channels in the logistics system.

Since, interruptions in any of the above four flows affect an organization's raw materials supply (purchasing), manufacturing (operations) and marketing (distribution) functions. According to Fawcett and Fawcett (1995)there exists a need to integrate these flows through effective management of infrastructure, materials, technology and people. In this thesis, the concern is with the supply chain management of NFCL. More specifically, it is concerned with the inbound and outbound logistics of the company.

Supply Chain Management Practices

In India approximately two percent of the GDP is spent on logistics (Planning Commission report-2002), whereas this Figure is 13 percent for developed countries. Supply chain management and logistics are still in the embryonic stage in India. The current lull in the economy is forcing many industries to examine their costs, and cut it down in size. Today excellent logistics management has become essential for success of companies. Logistics function includes the total flow of material, from the purchase of raw materials to delivery of completed products to the ultimate users. As such, it includes the activities of sourcing and purchasing, conversion including capacity planning, technology selection, operations management, production scheduling, materials planning, distribution planning and management of industry warehouse operations, inventory management, inbound, internal, and outbound transportation; linkage with customer service, sales, reverse logistics, promotion and marketing activities.

Successful supply chain management is extremely complex because of large number of players with varying interest or objectives are involved. Though the supply chain of each company has its own unique features, the following general principles help in management of supply chains.

- Begin with the customer
- Manage logistic assets
- Organize customer management
- Integrate sales and operations planning
- Leverage manufacturing and sourcing
- Focus on strategic alliances and relationship management
- Develop customer driven performance measures

A significant new trend has been evolving in logistics management in the last decade - one that involves the collaboration of all participants in the supply chain in order to reduce the cost of total logistics system. It has been referred to as "Supply Chain Management", "Logistics Partnership" or "Inter-Corporate Logistics Management". In traditional Logistics "total cost concepts" model, companies worked to manage logistics as an entity and to lower the total logistics costs to the organization. The model evolved balancing trade-off among production run lengths, inventory, transportation, and warehousing and customer service. Later an increasing number of companies realized that though the total cost concepts might

be useful, it is tainted because it does not consider the efficiency of the entire supply chain. The supply chain management on the other hand involves the active collaboration of two or more participants in the supply channel (Supplier, manufacturer, distributor, and/or customer) to manage all the logistics resources in the most efficient manner possible.

The concept of "quick response" gained broad favor as companies in all parts of supply chain developed an appreciation of its potent benefits. Quick response involves the integration of the supply chain, effectively linking retailers, suppliers (manufacturers/ distributors) and carriers in close communication and integrated decision making.

Key elements of quick response include:

- Point-of-usage data capture
- Hem - level management
- Rapid Communication
- Partnerships
- Discipline and commitment

Effective quick - response systems' benefits include lowering inventories by as much as 40 percent, improving in-stock availability significantly, cutting transaction and administrative costs in to half, reducing replenishment lead to a third or less of their former levels, identifying slow-selling items sooner, and reducing operating costs for all players in the supply chain.

Supply chain management strategy involves determination of what performance criteria the logistics system must maintain - more specifically, the service levels and cost objectives the logistics system must meet. As cost and service normally involve a trade-off, a company must consciously consider that trade-off and determine the desired supply chain performance. This process involves consideration of the company's strategic objectives, its specific marketing strategy and customer service requirements and its competitors' cost service position.

Supply chain planning involves the development and management of all logistics resources in order to attain the desired cost-service performance consideration, it might include number and location of warehouses, type of warehouses, mode and carrier selection, inventory position, inventory levels, order entry technologies, information system etc. Opportunities for differentiation - based on operational, logistics, or customer services

excellence are more likely to be exploited. Supply chain management tends to have a more visible and more important role in the Company. Investments in the supply chain function or infrastructure are more likely to be approved.

Just - in - time (JIT) Logistics: It is useful to classify JIT programs into two categories, JIT production and JIT logistics. These programs typically focus on the reduction of set up funds for key operations, the reduction of lot size, and the enhancement of quality - all leading to lower work - in - progress inventories.

JIT logistics programs, on the other hand, apply JIT principles to the management of raw materials, inventories and beyond supplies. For JIT logistics plans to work, four `Pillars' must be in place. They are:

- Stable production schedules
- Efficient Communication
- Co-coordinated transportation
- Quality control

These four principles are critical to the integrated management of suppliers. The 1990s have been called the "decade of customer service". All industry sectors are placing a premium on quality, including quality customer service. Serving customers as they want to be served and "making company easy to do business with" is competitive objective for the next millennium. At the same time the meaning of effective customer service is changing, and companies must meet an increasingly higher standard. Customer Service Pyramid is an effective framework for formulating a customer service strategy in a fluid marketing environment.

Logistics as a Process

According to Prof. Bernard La Lode of Ohio State University (1998) logistics is not a focused functional activity but one that enables the integration of activities across functions. An effective way to promote this expanded role for logistics is to position logistics as a process, not as an activity or function. These are three important sub-processes as part of the logistic process. They are:

- Integrated Production and distribution strategy development
- The replenishment process

- The order management process

A well-designed forecasting system can contribute significantly to logistic performance. Many consumer products companies are trying to operate with 25 to 60 percent forecast error (on the stock-keeping unit level) in their one month- out forecasts. This error range wreaks havoc with inventory levels and customer service performance. "Best Practice" companies, on the other hand, consistently are able to achieve 15 to 20 percent forecast error rates. Companies that perform poorly in their forecasting typically commit two or more of the "Six of forecasting" given below:

- Letting finances drive forecasts
- Having no forecast "owner"
- Having insufficient analytical support
- Using a single forecasting approach for every thing
- Having no sales and operations planning meeting
- Failing to track forecast error.

Many companies are discovering that distribution resource planning (DRP) systems can reduce costs, improve customer service, and better their inventory management. DRP systems provide a full view into the warehouse network by first examining demand at the end of the channel and accumulating requirements back through the warehouse network. This approach allows for full visibility of needs and better management of inventories. DRP involves both inventory management and distribution planning. A module of distribution requirement planning (DRP) extends the concepts of materials requirements planning in to a multi-echelon-warehouse inventory environment. The results are time-phased replenishment schedules for moving inventories across the warehousing network. DRP offers an accurate simulation of distribution operations with extended planning visibility, allowing logistics departments to manage all resources better.

Literature on Importance of Supply Chain

The last decade of this century has seen many significant changes. The important ones are: the end of cold war, breaking up of the former USSR, formation of trade blocks (EU, ASEAN, NAFTA, etc.), emergence of World Trade Organization, and globalization of World Economy. Feasibility of global sourcing and marketing of quality products and services at competitive prices in the world market have called for serious re-look into the logistics functions in such industries as steel, cement, fertilizer, chemicals, petroleum, etc., where

logistics cost forms a significant component of the cost of goods sold. Gyulaet. al. (1994)And Scully and Fawcett (1993) gives details on global manufacturing. Based on a survey of Loon Major European companies, Kearney (1995) observes that logistics function is becoming more demanding and complex as the business environment itself is becoming complex and demanding. The critical factors responsible for demanding logistics management are: (1) Escalating customer expectations and demand, (2) Cycle time compression, (3) Global sourcing, (4) Global market, (5) Corporate restructuring, (6) Supply chain partnership, (7) Productivity pressures and (8) Environment awareness.

Though supply chains have existence since the beginning of civilization, this name and associated approach to looking at the issue is new. The focus so far in the area has been to look at different aspects of the supply chain such as procurement, storage, production, distribution etc, separately and there are different specialists for each. An integrated view of the links as parts of a supply chain is of quite recent origin. Therefore, when one changes the focus from different functional areas to the supply chain concept, some fundamental issues arise that need to be addressed.

The entities of the chain or the departments of the supply chain become dominant and try to form sub-goals and achieve them at the expense of the total supply chain goal. Different entities in the supply chain have different strength. This leads to a condition that the chain is only as strong as the weakest link. The extra money spent in making some areas of the supply chain very strong is wasted because this extra strength does not in practice contribute to the operation of the total supply chain significantly. In a chain if two adjacent rings are not connected the chain is not one but two. The same is the case with the case of a supply chain where strong connections between adjacent links are vital for its existence and functioning. These are called supply chain disconnects. The presence of a loop or a cross-link in the supply chain creates multiple paths to choose from one end of the chain to another. At each such loop or cross-link the conditions under which each path should be taken should be spelt out clearly.

Looping and cross linking of supply chains create many information flow problems, information about the same thing coming from different links might not be at agreement. It has been found that in most supply chains there are people to study and look at the individual departments, because of the organizational structure followed, but almost no one looks at the

supply chain as such in total. It is the performance of this complete chain that ultimately matters.

Need for the study:

The specific need for the study of Supply Chain Management in Fertilizer industry with special reference to NFCL is to study the various primary activities of SCM like inbound logistics, operations, outbound logistics and sales and services as the agriculture is one of the strongholds of the Indian economy and accounts for 14.6 per cent of the country's gross domestic product (GDP) in 2009-10, and 10.23 per cent (provisional) of the total exports. Furthermore, the sector provides employment to 55 per cent of the work force The Government of India from time to time has taken considerable steps for the development of Agriculture Sector. Fertilizer in the agricultural process is an important vicinity of concern. Fertilizer industry in India has succeeded in meeting the demand of all chemical fertilizers in the recent years.

The **Indian Fertilizer Industry** is one of the allied sectors of the agricultural sphere. India has emerged as the third largest producer of nitrogenous fertilizers. The adoption of back to back Five Year plans has paved the way for self sufficiency in the production of food grains. In fact production has gone up to an extent that there is scope for the export of food grains. This surplus has been facilitated by the use of chemical fertilizers. The large scale use of chemical fertilizers has been instrumental in bringing about the green revolution in India.

The NFCL produces and markets a wide range of fertilizers. Urea (widely used) nitrogenous fertilizer is manufactured at the Kakinada Plant as well as marketed. And the pool urea is imported at the Kakinada and the Vizag Ports. The farming community in Andhra depends to a large extent on the urea produced by Nagarjuna Fertilizers and Chemicals Limited (NFCL). NFCL presently markets around 0.6 million tons of imported urea and 1.2 million tons of manufactured urea. NFCL is major urea provider for the Andhra Pradesh. This is the main reason to choose this company for my study.

Objectives of the study

The objectives of this study are

1. To study the supply chain of the Nagarjuna Fertilizers and Chemicals Limited
2. To understand the performance of various sectors and to compare the performance of NFCL with other private companies
3. To understand and analyze the various inputs (inbound logistics) of NFCL and to study how effective and efficient they are using in the SCM of NFCL
4. To study and analyze the various outbound logistics of NFCL
5. To study and analyze the problems of the Truck Drivers as they are the key factors of logistics and the supply chain management.
6. To develop models for integrated supply chain planning for Nagarjuna Fertilizers and Chemicals Limited.
7. To make suggestions for improvement.

Methodology

The analysis may be possible by studying the data available in the company. The methodology includes collection of secondary and primary data, sampling design, classification and tabulation of data and diagrammatic and graphical representation of data. Finally the above data is analyzed and reported

The secondary data was collected from organization records, management reports, the department of fertilizers and the Fertilizer Association of India and the special project reports to understand the present state of supply chain management primary activities.

The Primary data was collected from the truck drivers of in and around the organization with the help of questionnaire.

The questionnaire consists of close ended questions of both multiple – choice questions and checklist questions. The questionnaire has two parts. The first part of the questionnaire was relating to social aspects of truck drivers and the second part consisted of economic aspects of truck drivers and a total of 14 questions relating to age, educational qualification, Experience, Income, House details, Own house details, Rent details, marital status, No of children, Education of children, Spouse's education, Amenities in house, and

the problem creators on the road. The sample is selected based on random sampling. The Survey conducted in the city of Kakinada and its surrounding villages through questionnaires to 200 drivers.

Tools for Data Analysis

The processing and analysis of data was done with the help of the computer software StatistiXL (Statistical Package for Social Sciences) and STATISTICS XL software. Mean and other calculations and drawing of tables, charts and the figures are done by using MS Excel.

Testing of Hypothesis:

Chi – square (χ^2) test is used to test the 'goodness of fit' as it is the very powerful test for testing the significance of the discrepancy between theory and experiment was given by Prof. Karl Pearson. It enabled to find if the deviation of the experiment from theory is just by chance or is it really due to the inadequacy of the theory to fit the observed data.

Formula used:

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

Mean:

The mean (the expected frequencies) in each group or condition is calculated by adding up all the scores in a given condition (for 10years), and then dividing by the number of years (10) in that condition.

Table of calculations:

Financial year	Observed value	Expected value	O - E	$(O - E)^2$
∑=				

Decision rule:

At 5% level of significance and at the degrees of freedom 9 if calculated value of χ^2 is less than the tabulated value accept Null hypothesis and if calculated value of χ^2 is greater than the tabulated value reject Null hypothesis.

The correlation coefficient to determine the relationship between two properties:

The equation for the correlation coefficient is:

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

Where x and y are the sample means AVERAGE (array1) and AVERAGE (array2).

HYPOTHESIS:

The major hypotheses for the study are

1. There is no installed capacity underutilized by the company
2. There is an equal and regular or gradual increase in % change of both quantity and the values for inbound logistics
3. There is no supply and demand gap for pool urea
4. The company is paying minimum value to the less quantity of electricity purchased
5. The Company is not offering the consistent product mix by sourcing traded product from other firms
6. More production of Urea is not possible than its installed capacity
7. There is less production of ammonia than its installed capacity

Scheme of the Study

This thesis is organized under nine chapters. The **first chapter** presents introduction, need for the study and its significance, objectives and methodology of the study. The **second chapter** demonstrates a survey of literature relevant to the study. The **third Chapter** discusses Indian fertilizer industry. The **fourth chapter** deals with the profile of Nagarjuna Fertilizers and Chemicals Ltd. The **fifth chapter** represents the analysis of comparative study of public sector, cooperative sector and private sector of Indian fertilizer industry. The **sixth chapter** acquaints inbound logistics analysis in Nagarjuna Fertilizers and Chemicals Ltd. The **seventh chapter** constitutes the outbound logistics analysis in Nagarjuna Fertilizers and Chemicals Ltd. The **eighth chapter** portrays with the problems of Truck Drivers. At last but not the least the **ninth chapter** summarizes the findings from the data collected and recommendations related to this area and discuss scope for further related work.

Limitations of the study:

The major limitations for the study are

1. The study of inbound logistics is limited enough to the quantity and values as they are under the control of the govt. of India.
2. The study of outbound logistics is limited to the quantity and value only as the allocation and distribution is under the control market by the govt. of India.
3. The study of transportation is limited to the road as the railways are 100% reimbursed by the govt. of India
4. The study is limited to major part of secondary data as there is less scope for primary data
5. The population considered for studying the socio economic aspects of truck drivers is limited to the Kakinada town (both rural and urban).
6. The sample size taken is only 200 out of more than 500 truck drivers in the Kakinada town.

SUMMARY

The present study focused on the primary activities of Supply Chain Management in Fertilizer industry with special reference to Nagarjuna Fertilizers and Chemicals Limited, Kakinada. In order to find out and analyze the bottlenecks in SCM of NFCL and Fertilizer industry the secondary data of inbound and outbound logistics for 10Years (2001 – 2011) was collected from organization records, management annual reports, the department of fertilizers and the Fertilizer Association of India and the special project reports.

The Primary data was collected from the truck drivers of in and around the organization with the help of questionnaire. The sample is selected based on random sampling. The Survey conducted in the city of Kakinada and its surrounding villages through questionnaires to 200 drivers.

After collecting the data, processing and analysis of data was done with the help of the computer software StatistiXL (Statistical Package for Social Sciences) and STATISTICS XL software. Mean and other calculations and drawing of tables, charts and the figures are done by using MS Excel.